pity that Mr. Cope, who describes the specimen on which the larvæ were found, should not have taken the trouble of ascertaining its sex, instead of contenting himself with the statement "The free tadpole is carried on the parent."

The explanation of this extraordinary mode of "nursing" is to be found in a contribution by Hr. Aug. Kappler * to the life-history of Reptiles and Batrachians in Dutch Guiana. We have here to do with a quite new mode of parental provision for the safe rearing of the brood, and I append a translation of Hr. Kappler's remarks :—

"*Dendrobates trivittatus*, Spix.

"During the rainy season the female oviposits in small puddles, where the eggs are hatched, after which the frog removes the young tadpoles to other (larger) puddles. This is accomplished, as I have myself several times witnessed, by the frog entering the water, when all the tadpoles gather round and suck on to the parent, which leaves on its journey with an investment of from twelve to eighteen young tadpoles, 6 or 7 millim. long. Whether it is the male or the female that undertakes the carriage is unknown to me."

It is to be hoped that Messrs. Smith and Kappler's interesting observations may be before long supplemented by fuller accounts. Naturalists in the tropics do not seem to be fully aware of the rich mine of investigation which the breeding-habits of Batrachians afford them. The more our knowledge advances the more we realize the immense amount of secondary modifications in the development of Batrachians, quite irrespective of their relationships. What is more remarkable than the similarity of the eggs and the nursing-habits of such widely remote forms as *Alytes*, *Ichthyophis*, *Desmognathus*, and *Amphiuma*?

It is, however, held by Mr. Ryder † that this similarity between *Ichthyophis* and *Amphiuma* is "a confirmation of Prof. Cope's conclusions as to the taxonomic relations of these two types, and a very interesting instance of the way in which embryological data may become available."

On the Formation of the Antherozoids of the Hepaticæ. By M. Leclerc du Sablon.

The antheridia of the Hepaticæ are formed by an aggregation of rounded or oval cells. The cells of the superficial layers remain sterile and form the envelope; the interior cells play a more important part—each of them forms a motile antherozoid, capable of fecundating the oosphere and converting it into an ovum.

How does a cell, formed of a nucleus surrounded by protoplasm and a membrane, become converted into a spiral filament endowed with motion? The authors who have studied the formation of the antherozoids have answered this question in very different ways. According to some the nucleus disappears, and it is the protoplasm that furnishes the spiral filament; according to others the protoplasm does not perform any essential part, and it is the nucleus that, by elongating and coiling itself, directly forms the antherozoid. At the close of my researches upon the Hepaticæ I shall propose a third

* Das Ausland, 1885, p. 858. † Amer. Nat. 1888, p. 182.

solution, which appears to me to be more in accordance with the facts than the preceding.

As a first example I shall take *Metzgeria furcata*. The antheridia occur in involucra which are almost entirely closed and are situated themselves on the lower surface of the frond. When the mother-cells of the antherozoids have ceased dividing, the middle part of the membrane surrounding them soon dissolves; each cell is then completely free, only surrounded by a very delicate membrane, which will afterwards disappear. The nucleus, which was at first central, approaches the surface of the cell without changing in form or dimensions. At the same time all round the cell, following a great circle which touches the now excentric nucleus, a delicate thread of protoplasm is differentiated, becomes homogeneous and brilliant, and is coloured only with great difficulty by the ordinary reagents of the protoplasm and nucleus. This is the first indication of the formation of the antherozoid. It is to be observed that, at this period, the nucleus has not notably changed in form. We cannot therefore say that the nucleus alone forms the antherozoid by becoming elongate and slender. It is true that the nucleus has a point of contact with the filament; but by treatment with hæmatoxylin the colourless filament may be traced over the surface of the nucleus, now strongly stained violet.

This first phase of the formation of the antherozoid is of short duration, and appears to me to have hitherto escaped the notice of observers. In a rather more advanced state the different parts of the mother-cell retain the same relative positions; but the filament is thicker and more intimately united with the nucleus, the nucleus itself is smaller, and the protoplasm less dense. The filament therefore grows at the expense of the nucleus and protoplasm.

Still later the nucleus seems to have completely disappeared; its substance has been entirely employed in enlarging the antherozoid. The protoplasm also has almost completely disappeared; we see only a colourless space in the midst of the ring formed by the antherozoid. The direct observation of this stage of development led some authors to suppose that the nucleus disappeared and that the protoplasm then became condensed at the periphery of the cell to form the antherozoid. Soon afterwards the ring breaks, the filament elongates itself and becomes more slender, and gradually acquires the form of the adult antherozoid. It is only at this period that the two cilia appear at one of its extremities.

The antherozoids of the other Hepaticæ that I have studied (*Radula complanata*, *Frullania dilatata*, and *Alicularia scalaris*) are formed exactly in the same way as those of *Metzgeria furcata*. As these different species belong to groups pretty distinct from each other there is reason to suppose that the mode of formation of the antherozoids is very uniform in the family Hepaticæ. I hope, however, to extend my observations to a greater number of species and to publish figures which are necessary for the completion of such descriptions as those which I have just given.

The technical processes which I have employed in my observations are those which are ordinarily adopted in the investigation of the nucleus. To obtain good results, however, I have been obliged not to make use of materials hardened in alcohol; under such conditions, in fact, it becomes difficult to distinguish the protoplasm from the nucleus. In certain cases, at any rate, I think I may ascribe the mistakes of some authors to the use of materials hardened in alcohol. Treatment with hypochlorite of soda in very dilute solution has furnished good results.

To sum up: the antherozoids of the Hepaticæ are formed at the same time by the nucleus and the protoplasm of the mother-cell. The body of the antherozoid, therefore, not corresponding solely to the nucleus of the mother-cell, but to the nucleus and protoplasm together, there is not only a change of form of the elements of the cell, but there is at the same time a change of properties and of structure. The body of the antherozoid, which is more refractive and more homogeneous than the protoplasm or the nucleus, is also more difficult to stain with reagents, especially at the commencement of its formation. A complete transformation of the elements of the cell has taken place; we may therefore say that in becoming converted into an antherozoid the mother-cell has undergone a total renovation.—*Comptes Rendus*, March 19, 1888, p. 876.

On the Gemmules of some Marine Siliceous Sponges.
By M. E. Topsent.

As in the Spongillæ, multiplication by means of gemmules is observed in adddition to sexual reproduction in many siliceous sponges common on the shores of the Channel and belonging to different families, such as *Chalina oculata*, *C. gracilenta*, *Cliona vastifica*, and *Suberites ficus*.

The asexual germs which originate in the deeper parts of these various sponges consist essentially (1) of rather large elements, darkened by a great accumulation in their protoplasm of large shining granules, which conceal the cell-nucleus; and (2) of a keratode envelope. In none of the marine species here in question do the gemmules attain the same degree of complication as those of the Spongillæ; their envelope is not pierced by a foramen, and the spicules with which it is often armed are not special ones.

The gemmules of *Chalina oculata* are, however, still rather complex. They are developed in small numbers (not more than thirty) in the lower region of the hard and apparently lifeless peduncle of this branching sponge. Attached to the yellowish fibres of the skeleton they appear as ovoid bodies of a milk-white colour, three or four times the size of the gemmules of *Spongilla fluviatilis* for example. Their keratodic envelope is supported throughout its whole extent by acerate spicules arranged parallel to each other; further, some horny fibrils, also containing spicules, intercross in the middle of the internal cellular mass.

Bowerbank, without knowing it, had discovered these gemmules in a very short piece of peduncle which he took for a new sponge (Shetland Islands) and named *Diplodemia vesicula*. From the description of this species and its *ovaries*, O. Schmidt in 1870 thought he recognized a fragment or a young form of a Chalinean. Now it seems no longer doubtful that the unique *Diplodemia* is the broken foot of a *Chalina oculata*.